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RETROSPECTIVE COHORT STUDY OF TOBACCO USE AND OUTPATIENT CLINIC VISITS IN A MILITARY POPULATION

By

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"The views expressed in this article are those of the author and do not reflect the official policy or position of the United States Air Force, Department of Defense, or the U.S. Government. "

DEDICATION

To the Men and Women of the United States Air Force.

Service to you is my life's work

RETROSPECTIVE COHORT STUDY OF TOBACCO USE AND OUTPATIENT CLINIC VISITS IN A MILITARY POPULATION

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PAUL H. NELSON, B.A., M.D.

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RETROSPECTIVE COHORT STUDY OF TOBACCO USE AND OUTPATIENT CLINIC VISITS IN A MILITARY POPULATION

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The University of Texas at Houston Health Science Center
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Approximately sixty million Americans, almost thirty percent of the adult population, use tobacco products. Tobacco use is estimated to cause 6-12% of total medical expenditures in the United States, and is generally regarded as the most important avoidable health risk behavior in this population. Tobacco is a problem of similar magnitude in the United States military and is the focus of local and national efforts to reduce tobacco use in this population.

Causal links between tobacco use and chronic illnesses, especially respiratory, cardiovascular, and malignant disease, are well established. Effects of tobacco on young healthy populations with non-chronic diseases are less well studied.

This retrospective cohort study described the relationships between tobacco use and the thirty most common disease categories in an active duty Air Force population. It controlled for age, sex, race, rank, body mass index, and performance on a fitness test in two exposure groups defined by self identified tobacco use. Regression modeling was used to define odds ratios and confidence intervals which could approximate the relative risk that

tobacco use represented in this population. Tobacco use was expected to be related to an increased utilization of outpatient medical care for conditions where tobacco use was either causally or co-morbidly related, and show no increase in groups of diseases where tobacco use has not been associated.

Results of the study were mixed. As expected, tobacco use was a strong independent predictor of an individual seeking outpatient care for co-morbid psychiatric and behavioral conditions. Tobacco use did not consistently increase an individual's risk of seeking care for musculoskeletal, administrative, ophthalmology, screening or physical exam appointments. While the causal relationship between tobacco use and respiratory symptoms in all age groups is well established, tobacco use was associated with either no change or decreased usage of medical care for most respiratory disease categories. Future study is appropriate to more fully evaluate the relationship between tobacco use and common outpatient disease categories in this population.

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[redacted] You are beacons for your dad.

[redacted] You have given everything and more. You rock!

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Thesis submitted to the M.P.H. Committee on June 2, 2003.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

INTRODUCTION

Approximately sixty million Americans, almost thirty percent, use tobacco products currently (Substance Abuse and Mental Health Services Administration, 2002). Tobacco related illness currently accounts for between 6% and 12% of the United States health care expenditures, while indirect costs, more difficult to measure, probably far exceed this figure (Fellows, Trosclair, Adams, & Rivera, 2002; Max, 2001). Tobacco related illness and associated lost duty time conservatively cost the United States Department of Defense (DoD) $584 million in direct medical expenses and $346 million in lost duty time annually (in 1995 dollars) due to smoke breaks and hospitalizations (Helyer, Brehm, & Perino, 1998). The DoD and the Veteran's Administration (VA) currently have a combined medical budget of over $45.8 billion (Wilensky & Hammerschmidt, 2002). If Fellows' estimates apply to this population, then the actual cost attributable to tobacco of health care for our military beneficiaries may be as high as $2.75 to $5 billion in medical costs alone. Further, as the active duty military has declined from 2.4 to 1.5 million personnel in the past decade, retirees who disproportionately carry the burden of chronic diseases related to tobacco use have been the only expanding group of DoD medical beneficiaries (Wilensky & Hammerschmidt, 2002).

As budgets get tighter, all expenses will fall under tighter scrutiny. Cost estimates of tobacco related illness now approach the $4.5 billion price tag of a new

Nimitz Class aircraft carrier (United States Navy, 2002), and dwarf the $450 million cost of a squadron of F-16 fighter aircraft (United States Air Force, 2001). Senior military leaders now recognize the enormous drain on the military budget that caring for these chronic diseases represents. They have intensified pressure on military medical leaders to shift resources to prevention programs to reduce current and future costs associated with tobacco.

Overview of Tobacco Policy

Tobacco Policy in the United States

The experience with tobacco policy in the nation mirrors that of the military, so any evaluation of the DoD policy should start with an historical overview. Tobacco use ballooned in this country in the early 20th century after the introduction of commercially viable cigarette production methods and mass marketing of tobacco products. It was also aided by free distribution of cigarettes to military members in the two world wars. Until the last decades of this century, public policy was characterized by generous subsidies for tobacco farmers, low cigarette taxes, and few restrictions on tobacco use. Policy began to shift in the 1950's when an increasing body of scientific literature linked tobacco with the development of chronic diseases. The culmination of this period was the landmark 1964 Surgeon General's Report which contained the provocative statement (for the time) "Cigarette smoking is a health hazard of sufficient importance in the United States to warrant appropriate remedial action" (U.S. Department Of Health, Education,

and Welfare, 1964, p. 33). As an educated society awoke to the hidden costs of a nation addicted to tobacco, tobacco taxes increased, subsidies declined, tobacco use became less socially acceptable, and tobacco users were confronted with increasing tobacco restrictions. Due largely to these policy changes, tobacco abuse decreased from 52% in 1964 to 28% in 1994 (History of the 1964 Surgeon General's Report on Smoking and Health, 1996).

Tobacco Policy in the Department of Defense, 1986-2000

Similarly, the Department of Defense began to seriously address tobacco policy in the late 1980's after the 1986 DoD directive "Health Promotion," which devoted a significant section towards tobacco control. This document mandated that each service provide military health beneficiaries access to tobacco cessation information and motivation and that each base have an active tobacco cessation program. Tobacco use was also restricted in many base buildings and military vehicles (Department of Defense, 1986, updated 1994). The traditions of free cigarettes in military rations as a "benefit," smoking in the oxygen enriched cockpits of fighter aircraft, and deeply discounted tobacco sales, have gradually given way to bans on tobacco in basic training, and smoke free ships, aircraft, and work and recreation places. Most recently, after 15 years of debate, the tax exempt status of tobacco products in on-base commissaries ended. This promising development may provide a stimulus for more to quit (National Center for Chronic Disease Prevention

and Health Promotion, 2000). With these rapid policy changes, tobacco use in the military has dropped rapidly from a high in 1982 of 51.4% to 29.9% in 1998. Recently, the trend appears to level out, which is similar to the trend in the civilian population noted since the 1980's (Bray et al., 1999).

Current Challenges of Policy in the Department of Defense

Even with these powerful policy changes, some tobacco related messages in the military remain mixed. Smoking in uniform is still acceptable at most duty locations, tobacco is not acknowledged on performance reports, and "smoke pits" are often the only out-of-door break facilities available to most workers. Finally, preoccupation with mandatory weight standards may actually increase tobacco use because fear of breaking military standards encourages many military smokers to use tobacco to control their weight (Russ, Fonseca, Peterson, Blackman, & Robbins, 2001).

Policy change has been the driving force behind decreased prevalence of tobacco use in both civilian and military populations in the past 20 years. These sentiments are echoed in the most recent report of the Surgeon General which states "...approaches with the largest span of impact (economic, regulatory, and comprehensive) are likely to have the greatest long-term, population impact," while educational and clinical efforts "...are of greater importance in helping individuals

resist or abandon the use of tobacco" (National Center for Chronic Disease Prevention and Health Promotion, 2000, At a Glance section, p. 2).

However, most military bases still rely primarily on tobacco cessation programs that emphasize the non-controversial approach to helping individuals or small groups to quit. These activities usually take place in a base clinic or wellness center, away from the worksite. While these individual programs are well intentioned, some may argue they actually divert attention away from the tobacco policy changes which will have a greater span of influence. Based upon the cumulative body of scientific literature, policy change is the place to focus future efforts at reducing the prevalence of tobacco use in the military.

Implementing policy at the local base level with commanders who have smaller forces but more operational commitments will be difficult. The line commander is graded on his short term ability to rapidly deploy combat units to an austere environment and maintain their effectiveness for an unlimited duration. The causal relationship between tobacco and the burden and costs of chronic disease do not speak to these operational commitments. Only by making prevention efforts more relevant to the line commander's short term operational responsibilities will they successfully garner support. This paper will next present an overview of some applicable literature that may aid in communicating the tobacco issue to the line commander.

Selected Review of Tobacco Literature

Study Assumptions

Most studies dealing with tobacco related outcomes depend upon self administered questionnaires to detail smoking history. Petitti and associates examined this approach in a study population of 19-72 year olds in a prepaid medical care plan and concluded that in this population the self administered questionnaires were as accurate as physiologically based methods for ascertaining tobacco use (Petitti, Friedman, & Kahn, 1981). Care must be taken, however, when applying this reasoning to a military population because some military smokers may perceive that they will be subjected to administrative action based on their self reported tobacco use. Research is currently ongoing to determine the correlation of self-reported tobacco use in military populations from different data sources. Discrepancies here could represent a potential bias that should be acknowledged but will be difficult to control in available data sources.

Links Between Tobacco and Disease

The irrefutable link between tobacco and chronic diseases in older populations is well documented in the literature and summarized by multiple reports issued by the Surgeon General in the past 25 years. The links between tobacco use and illness in children and young adults is also strong but evidence is greatest for direct causality of respiratory illness (Appendix 1).

Tobacco Related Studies with Specific Military Relevance

More relevant to the line commander are studies that link tobacco with job performance. Here, the literature is not as extensive, but is generally supportive of links between tobacco use and decreased physical fitness, sickness burden, and absenteeism in a young population. These results are summarized below.

Tobacco Studies Related to Physical Performance

In one of the earliest studies dealing with smoking exposure and exercise in a military population, Cooper studied 419 active duty Air Force airmen and showed that smokers performed worse on a 12 minute run test before, during, and after a six week training course. This finding is of interest because these subjects had not smoked long enough for the expected chronic effects of tobacco smoke to affect their cardiovascular and respiratory systems (Cooper, Gey, & Bottenberg, 1968). David showed a similar finding with a one mile run test and with a varied battery of military relevant tasks to include jumping, dodging, and crawling (David, 1968). Jensen's pilot study looked at performance on the U.S. Army Physical Readiness Test, composed of a two mile run, push-ups, and pull-ups. He found statistically significant decreases in all outcomes except the push-up (Jensen, 1986). More recently, Bahrke and colleagues conducted several studies dealing with the Army fitness test. Interestingly, they did not find a statistically significant change in run times. While this result contradicted previous studies, they did show differences in

tests of anaerobic strength (push-up and pull-up) similar to the results from David (Bahrke, Baur, Poland, & Connors, 1988).

Tobacco Effects on Socialization and Cognitive Performance

Tobacco's effects on cognitive performance outcomes are more varied and are well described in the Surgeon General's Report on the Health Consequences of Using Smokeless Tobacco. Some tobacco proponents may point to the commonly perceived "benefits" of continued tobacco use, most importantly avoidance of the nicotine withdrawal syndrome and its related performance and concentration decrements. Further, tobacco products play a role in stress relief and socialization for many nicotine addicts (U.S. Department of Health and Human Services, 1988).

Estimating Burden of Disease in a Military Population

The impact of smoking on a population may also be evaluated by estimating the burden of disease based on direct medical costs such as hospitalizations and visits to the clinic. For example, Pronk et al. studied lifestyle health risks in a civilian population and demonstrated an 18% increase in direct health care costs in smokers aged 40 or over compared to a similar group of non-smokers. This is consistent with previous literature, but his findings may have limited applicability in a young military population because of the population's age and study setting (Pronk, Goodman, O'connor, & Martinson, 1999).

More directly applicable was the recent study by Robbins et al. This looked at the short term population implications of tobacco use on hospitalizations and

associated convalescent days away from work in a military population. Robbins demonstrated a tobacco related population attributable risk fraction of between 3.0% (women) to 14.1% (men) for lost workdays, and a 5.0% (women) to 7.5% (men) for hospitalizations in an Army population. This study was a large (87,991 population), well designed, historical cohort study which controlled for potential confounders of age, race, rank, alcohol use, aerobic exercise, and body mass index (Robbins, Fonseca, Chao, Coil, Bell, & Amoroso, 2000). The study results provided a useful estimate of the contribution that tobacco makes for serious diseases (requiring hospitalization) in a young military population. However, because hospitalization is still a relatively rare occurrence in this healthy young population, this indicator alone might underestimate the group performance decrement that tobacco plays in a military organization.

Robbins et al. followed with a cohort study of tobacco use and short term costs of medical care and lost duty time in 5164 active duty Air Force members. When controlling for age, sex, and race, they found tobacco use was associated with significantly higher costs of medical care. Based upon the expected time away from work for smokers due to smoke breaks, hospital days, and clinic visits, they summarized the cost of tobacco use to the USAF as $20 million in direct medical care (in 1997 dollars) and $87 million in lost productivity. Lost productivity is especially significant for the military commander because it corresponds to an Air Force wide

loss of 3573 full time equivalents of manpower. Note that this figure represents a larger population than that of 40% of the current Air Force bases total population (Robbins, Chao, Coil, & Fonseca, 2000).

This study had several limitations. Most importantly, because it included only one stateside TriCare region, the population may not be representative of the Air Force population as a whole. For example, the self-reported smoking rates in the study were lower than the Air Force average reported in the DoD survey (Bray et al., 1999). Days on "quarters" and convalescent days were not included, which would tend to underestimate the true burden of disease on a population. Finally, because medical care was reported in aggregate, establishing causality of tobacco related illness and differences in categories of diseases which could link demand utilization and tobacco control efforts may not be apparent.

Avenues for Further Research

The literature supports a causal relationship between tobacco use and certain measures of individual readiness in a military population. A causal relationship between decreasing tobacco use and decreasing costs of chronic diseases in an older population also exists. However, a similar causal relationship, while expected, has not yet been conclusively demonstrated in the young adult military population. This is important because tobacco reduction strategies have already been advertised to military commanders as both force enhancement and cost containment strategies.

A reasonable follow-up study would examine a larger Air Force population to minimize selection bias. It could consider diagnosis specific disease categories to further describe their contributions to total morbidity in this population. One would hypothesize that a positive correlation between tobacco use and outpatient clinic utilization exists in a larger representative Air Force sample. This correlation would be expected to be strong where clear causal and pathophysiological relationships exist between tobacco and disease exists. For example, a strong positive correlation would be expected between tobacco use and visits for respiratory disease. A correlation between tobacco use and other co-morbid behavioral conditions would also be expected. For example, tobacco use and alcohol use are common co-morbid behavioral conditions, but the literature does not show that decreasing tobacco use would decrease alcohol use (Anthony & Echeagaray-Wagner, 2000). For other disease categories where tobacco had no causal or co-morbid relationship, one would expect no increase in clinic visits related to that disease among tobacco users. Results congruent with these expectations would add support to the use of tobacco demand reduction strategies as a short term cost control strategy in this population.

Study Purpose

This study measured the disease specific association between tobacco use and the thirty most common outpatient disease categories in an active duty United States Air Force population. Through an historical prospective design it followed a cohort

composed of either self identified tobacco users or non-tobacco users for a one year period. It controlled for the potential confounders of age, sex, race, rank, performance on an exercise tolerance test, and body mass index to determine the tobacco associated odds ratios for each outpatient disease category, coded according to the Agency for Healthcare Research and Quality Clinical Classifications Software (AHRQ CCS) (APPENDIX 2) (Clinical Classifications Software (ICD-9-CM) Summary and Download, April 2003).

METHODS AND PROCEDURES

Study design

This study used an historical prospective cohort design. The study included all members of the active duty United States Air Force (USAF) who took the mandatory Air Force cycle fitness test and associated questionnaire between 1 Jan 2001 and 31 Dec 2001, and who remained on continuous active duty for the subsequent 365 days. The cohort, made of two exposure groups, was defined by self identified tobacco use identified on this questionnaire. Primary diagnoses for all outpatient visits seen in the military medical system, arranged by ICD-9 codes, were compiled for each individual for the subsequent 365 days from the initial fitness test.

Administrative and Ethical Concerns

All data were available in DoD secondary data sources and were accessed through the USAF Medical Operations Agency/Population Health Support Division (AFMOA/PHSD) at Brooks Air Force Base, Texas. Personal identifiers were stripped by the data base administrator prior to release to the primary investigator. The primary investigator obtained written permission from the data base administrator, the Air Force 311th Human Systems Wing, and the University of Texas School of Public Health Research Services Center prior to beginning data manipulation. All data were maintained in a secure fashion and reported in aggregate form.

Primary Exposure Variable and Potential Confounders

Tobacco use, the primary exposure variable, was obtained through the Air Force fitness data base. Smoking status was reported as one of 8 categories (Table 1). The data were re-categorized as either "current tobacco user" or "non tobacco user." If more than one response was recorded during the calendar year, the first test questionnaire results were used for the study.

Potential confounding variables included demographics data from the Air Force Personnel Center (AFPC) data base, accessed through AFMOA/PHSD. Sex was verified as "male" or "female." Age (on the date of the fitness test) was categorized as "17-24 years old," "25-33 years old," or "greater than 33 years old," representing tertiles of age in this population. Race was categorized as "white," "black," or "other" according to reported groupings in the data base. Military rank (on the date of the fitness test) was classified as "junior enlisted" (E1-E6), "senior enlisted" (E7-E9), "junior officer" (O1-O3), and "senior officer" (O4-O6).

Other potential confounders were obtained from the fitness data base. Heights and weights from the mandatory weigh-in administered during the fitness test were treated as continuous variables, rounded to the nearest integer. Body mass index (weight in kilograms divided by height in meters squared) was calculated, rounded to the nearest integer, and also treated as a continuous variable. Performance on the mandatory fitness exam was categorized as either "pass," "fail,"

or "indeterminate," based upon the age/sex specific minimum Air Force standards. These standards are correlated with VO2 max and thus served as a surrogate for aerobic fitness (Air Force Materiel Command, 5 April 2002). The potential confounding variables (age, sex, race, rank, BMI, and performance on the fitness test) were evaluated for statistical differences between exposure groups (tobacco users and non-users) using the Chi-squared test at the $p < .05$ level.

Statistical Methods

Determination of Variable Completeness

Any individual that did not complete a fitness evaluation or did not self-report tobacco use status was excluded from the study. All other variables including age, sex, rank, weight, height, and performance on the fitness test were evaluated for completeness. No variables had less than a predetermined 75% completeness rate, so none were excluded from the study.

Comparison of Exposure Groups

Tobacco use was self reported as one of eight criteria. The numbers of tobacco users in all categories except "cigarette" were too small to be statistically studied, so they were re-categorized to treat tobacco use as a dichotomous variable. The comparison of exposure groups is shown in Table 2.

Exclusion Criteria

Any individual who was not on continuous active duty during this calendar year, who did not have a valid fitness test, or who did not self report tobacco use

during the test period was excluded by the data base manager prior to release of the data set. All general officers (112 members with rank O7-O10) were excluded prior to the release of the data set because of the potential for identification. The Air Force active duty population at the end of January 2001 was 350,087, while 247,692 (70.8%) individuals met the criteria for inclusion in the initial data set released to the primary investigator. These 247,692 individuals generated 1,735,050 outpatient medical visits to military treatment facilities during the 365 day study period.

Individuals were excluded by the primary investigator if they had missing data for any confounding variable including age, sex, rank, height or weight (which would preclude calculation of the BMI), or if they had invalid or unknown responses to such categories. The calculation of BMI based on recorded values presented a special problem because of the potential for measurement error. In the initial data set, recorded heights ranged from 36 to 90 inches, while recorded weights ranged from 65 to 497 pounds. The primary researcher chose to exclude individuals with heights above or below the minimum or maximum sex specific Air Force enlistment standards (60-80 inches for males, and 58-80 inches for females). Individuals in the highest or lowest 0.01% of weight arranged by sex were also excluded. This produced an inclusion range of 70-250 pounds for females and 100-300 pounds for males. BMI was calculated only for personnel meeting these height and weight inclusion criteria.

Dependent Variable Classification

The data released to the investigator were classified by ICD-9 codes, regrouped into the 260 AHQR CCS codes, and arranged in descending frequency order. The 70,644 visits (4.1% of total study) that were not coded were excluded as a category. The thirty most frequently reported disease categories were compared between the initial data set and the data set based upon the exclusion criteria for differences for order and percentage of total visits. The rank order between the two groups was the same, and the percentages were also the same to +/- 0.01%.

In each of these thirty CCS categories, each individual was assigned a dichotomous variable (yes/no). This signified whether that individual had received any outpatient care for a condition in that category during the study period.

Analytic Techniques

Simple Logistic Regression to Establish Inclusion of Variables

For categorical data, referent categories were assigned as Caucasian race, female gender, junior enlisted rank, and a passing score on the fitness test. All categorical and continuous variables were tested prior to inclusion in the final multivariate logistics regression. This was done by performing Chi-squared procedures and establishing that variable's significance to the $p<0.20$ level in the most common outpatient disease category (255, Administrative/social admission). All confounding variables were statistically significant to this level, so all were included in the final multivariate logistics regression model.

Multiple Logistic Regression

The data from cohorts, defined by treating tobacco use as a dichotomous variable and excluding all missing, incomplete or invalid variables, was analyzed using multiple logistic regression techniques. Caucasian race, female gender, junior enlisted rank, and a passing score on the fitness test were considered referents for categorical data. These regression models produced odds ratios with 95% confidence intervals and estimated beta coefficients with standard errors and p-values for each of the thirty outcome variables. This data described the associations of tobacco use and disease categories in this population. Full regression models are shown in Appendix 3 while regrouped summarized data are shown in Table 4.

Statistical Support

The AHQR CCS downloadable version was used for initial coding. All statistical analysis was completed with Statistical Analysis System (SAS) Version 8.

RESULTS

Table 1

Self Reported Tobacco Use in Original Data Set

Type of Tobacco Used	Number of individuals	Percentage
None	175 687	71.24%
Cigarette	53 069	21.52
Pipe/Cigar	3 835	1.55
Smokeless	9 932	4.03
Cigarette & Pipe/Cigar	1 071	0.43
Cigarette & Smokeless	2 414	0.98
Pipe/Cigar & Smokeless	122	0.05
All Three	495	0.20
Total	246 625	100.00%

The overall rate of tobacco use in the Air Force is currently estimated to be 28.7% based upon the results of self reported tobacco use in this study. These results are similar to those reported by Bray in 1999 (Bray et al., 1999). As seen in Table 1, a

majority of tobacco users are either exclusively cigarette smokers, or use cigarettes in addition to another type of tobacco.

Table 2
Demographic Characteristics by Smoking Status and Gender

	Non-Tobacco User (n=174867)				Tobacco User (n=70513)				P-Value Non-Tobacco vs Tobacco User
	Male (n=140287)		Female (n=34508)		Male (n=60483)		Female (n= 10030)		
	Mean	Stderr	Mean	Stderr	Mean	Stderr	Mean	Stderr	
Total Number of Visits	6.14	0.02	10.94	0.05	5.93	0.03	12.11	0.11	<0.0001
Age (year)	31.09	0.02	28.40	0.04	27.79	0.03	25.70	0.07	<0.0001
Height (inch)	70.39	0.01	64.97	0.01	70.38	0.01	65.09	0.03	<0.0001
Weight (lb.)	183.14	0.07	140.57	0.11	179.90	0.11	140.52	0.20	0.0385
BMI	25.98	0.01	23.40	0.02	25.52	0.01	23.31	0.03	<0.0001
	N	%	N	%	N	%	N	%	
Race: Caucasian	106 605	75.99	21 101	61.15	50 609	83.67	7 827	78.04	Reference
African-American	22 552	16.08	9 879	28.63	6 007	9.93	1 358	13.54	<0.0001
Others	11 130	7.93	3 528	10.22	3 867	6.39	845	8.42	<0.0001
Military Rank: Jr. Enlisted	90 125	64.37	25 265	73.35	52 671	87.18	9 238	92.18	Reference
Sr. Enlisted	16 312	11.65	1 972	5.72	4 520	7.48	438	4.37	<0.0001
Jr. Officer	19 673	14.05	4 989	14.48	2 270	3.76	283	2.82	<0.0001
Sr. Officer	13 904	9.93	2 220	6.44	957	1.58	63	0.63	<0.0001
Fitness Test: Pass	94 708	67.51	25 769	74.68	39 586	65.45	7 783	77.60	Reference
Indeterminate	7 088	5.05	3 709	10.75	2 440	4.03	791	7.89	<0.0001
Fail	38 491	27.44	5 030	14.58	18 457	30.52	1 456	14.52	<0.0001

As seen in Table 2, male and female Air Force personnel, regardless of tobacco use, tended to utilize medical care at rates significantly higher than an adult population in a civilian managed care setting does (Tuso, Murtishaw, & Tadros, 1999). Tobacco users were more likely to be young, Caucasian, male, and of lower military rank in this study population. This is a similar experience to the smoking demographics in the United States population, where youth, Caucasian race, male

sex, and lower socioeconomic and education status all confer a higher risk of tobacco use (Substance Abuse and Mental Health Services Administration, 2002).

Table 3

Thirty Most Common Disease Categories in Cohort Study

Visit Ranking			Cohort Population				
Title	Rank	Code	Number of Total Visits	Percent of Total Visits	Cumulative Percentage Total visits	Percentage of Population with Visit for Condition	Mean Number of Visits per Individual with Condition
Administrative/ social admission	1	255	187 436	11.37	11.37	40.35	1.89
Medical examination/ evaluation	2	256	132 907	8.06	19.43	38.86	1.39
Other upper respiratory infections	3	126	87 220	5.29	24.72	24.17	1.47
Blindness and vision defects	4	89	73 185	4.44	29.16	21.67	1.38
Spondylosis, intervertebral disc disorders, other back disorders	5	205	68 490	4.15	33.32	10.30	2.71
Sprains and strains	6	232	63 009	3.82	37.14	12.05	2.13
Other connective tissue disease	7	211	62 493	3.79	40.93	10.83	2.35
Other aftercare	8	257	52 791	3.20	44.13	11.81	1.82
Other non-traumatic joint disorders	9	204	45 121	2.74	46.87	8.90	2.07
Other skin disorders	10	200	36 478	2.21	49.08	9.75	1.53
Other upper respiratory disease	11	134	34 663	2.10	51.19	8.62	1.64
Other female genital disorders	12	175	33 411	2.03	53.21	10.21	1.33
Other eye disorders	13	91	32 442	1.97	55.18	10.65	1.24
Contraceptive and Procreative Management	14	176	31 504	1.91	57.09	8.23	1.56
Joint disorders and dislocations, trauma related	15	225	28 289	1.72	58.81	3.27	3.52
Viral infection	16	7	25 909	1.57	60.38	7.30	1.45
Other mental conditions	17	74	25 294	1.53	61.92	3.35	3.08
Other bone disease and musculoskeletal deformities	18	212	24 726	1.50	63.42	2.92	3.45

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Table 3 (Continued)

Title	Rank	Code	Number of Total Visits	Percent of Total Visits	Cumulative Percentage Total visits	Percentage of Population with Visit for Condition	Mean Number of Visits per Individual with Condition
Rehabilitation care, fitting of prosthesis, and adjustment	19	254	24 097	1.46	64.88	2.14	4.60
Normal pregnancy and/or delivery	20	196	23 741	1.44	66.32	1.98	4.90
Alcohol-related mental disorders	21	66	22 738	1.38	67.70	0.88	10.49
Other screening for suspected conditions (not mental disorders)	22	258	22 020	1.34	69.03	6.19	1.45
Other ear and sense organ disorders	23	94	21 536	1.31	70.34	6.51	1.35
Residual codes, unclassified	24	259	19 179	1.16	71.50	4.54	1.72
Allergic reactions	25	253	18 945	1.15	72.65	4.88	1.58
Personal history of mental disorder, mental and behavioral	26	75	17 759	1.08	73.73	4.70	1.54
Anxiety, somatoform, dissociative, and personality disorder	27	72	16 172	0.98	74.71	2.47	2.67
Affective disorders	28	69	16 000	0.97	75.68	1.40	4.64
Headache, including migraine	29	84	15 328	0.93	76.61	3.52	1.77
Other nutritional, endocrine, and metabolic disorders	30	58	15 022	0.91	77.52	2.94	2.08

Table 3 shows the rank order of the thirty most common CCS diagnostic codes in the study. The most common disease categories were compared between the initial data set and the data set based upon the exclusion criteria for differences for both rank order and percentage of total visits. The rank order between the two groups was the same, and the percentages were also the same to +/- 0.01%.

Only in ten categories did the percentage of the population seeking care for a condition exceed 10%. This was clustered primarily among the administrative visits (255) and examination/evaluations (256) the two ocular categories (89 and 91, which

included many routine optometry appointments), a respiratory category (126), four musculoskeletal categories (205, 232, 211, 257), and a gynecologic category (175).

Pregnancy related visits (196) generated a large number of visits per patient. Otherwise, for individuals seeking care in a particular category, the mean number of visits tended to be between one and two visits. An exception to this trend was in certain musculoskeletal diagnosis (225, 212, and 254) and a majority of the psychiatric diagnosis (74, 66, 4and 69). In these categories a relatively small number of individuals had multiple repeated visits for the same condition. Especially noteworthy were the mean number of visits per patient with alcohol related mental illness (66), affective disorders (69), or rehabilitation care (254).

Table 4

Adjusted Odds Ratios for Tobacco's Effects on Grouped CCS Disease Categories

Category	Code	Odds Ratio	95% Confidence Limits		Percentage of Total Visits
Administrative					
	255	Administrative/social admission			
		1.022	1.003	1.041	11.37

Continued on Next Page

Table 4 (Continued)

Category	Code	Odds Ratio	95% Confidence Limits		Percentage of Total Visits
Examinations and Screening					
	256	Medical examination/evaluation			
		0.975	0.957	0.994	8.06
	258	Other screening for suspected conditions (not mental disorders)			
		0.939	0.902	0.977	1.34
Ophthalmologic					
	89	Blindness and other vision defects			
		0.831	0.812	0.851	4.44
	91	Other eye disorders			
		0.850	0.824	0.877	1.97
Musculoskeletal					
	205	Spondylosis, intervertebral disc disorders, other back disorders			
		1.032	1.002	1.064	4.15
	232	Sprains and strains			
		0.980	0.953	1.008	3.82
	211	Other connective tissue disease			
		0.890	0.863	0.917	3.79
	204	Other non-traumatic joint disorders			
		0.958	0.927	0.990	2.74

Continued on Next Page

Table 4 (Continued)

Category	Code	Odds Ratio	95% Confidence Limits		Percentage of Total Visits
Musculoskeletal (Continued)					
	225	Joint disorders and dislocations, trauma related			
		0.930	0.883	0.980	1.72
	212	Other bone disease and musculoskeletal deformities			
		0.916	0.866	0.970	1.50
	254	Rehabilitation care, fitting of prosthesis, and adjustment			
		0.938	0.879	1.001	1.46
Respiratory					
	126	Other upper respiratory infections			
		0.973	0.953	0.995	5.29
	134	Other upper respiratory disease			
		0.732	0.707	0.758	2.10
	7	Viral infection			
		0.978	0.945	1.013	1.57
	94	Other ear and sense organ disorders			
		1.055	1.017	1.094	1.30
	253	Allergic reactions			
		0.917	0.878	0.958	1.15
Behavioral and Psychiatric					
	74	Other mental conditions			
		1.211	1.154	1.272	1.53

Continued on Next Page

Table 4 (Continued)

Category	Code	Odds Ratio	95% Confidence Limits		Percentage of Total Visits
Behavioral and Psychiatric (Continued)					
	66	Alcohol related mental disorders			
		3.313	3.022	3.632	1.38
	75	Personal history of mental disorder, mental and behavioral			
		1.253	1.203	1.305	1.08
	72	Anxiety, somatoform, dissociative, and personality disorder			
		1.135	1.072	1.201	0.98
	69	Affective disorders			
		1.311	1.218	1.410	0.97
Other Categories					
	257	Other aftercare			
		0.970	0.942	0.998	3.20
	200	Other skin disorders			
		0.897	0.869	0.926	2.21
	175	Other female genital disorders			
		0.872	0.833	0.913	2.03
	176	Contraceptive and procreative management			
		0.938	0.906	0.972	1.91
	196	Normal pregnancy and/or delivery			
		1.046	0.975	1.124	1.44

Continued on Next Page

Table 4 (Continued)

Category	Code	Odds Ratio	95% Confidence Limits		Percentage of Total Visits
Other Categories (Continued)					
	259	Residual codes unclassified			
		1.066	1.020	1.115	1.16
	84	Headache, including migraine			
		0.945	0.899	0.994	0.93
	58	Other nutritional, endocrine, and metabolic disorders			
		1.046	0.990	1.106	0.91

Twenty two of the thirty most common disease categories from table 3 were regrouped into six broad categories shown in table 4: administrative, examinations and screening, ophthalmologic, respiratory, musculoskeletal, and behavioral. These twenty two grouping together accounted for 63.7% of the total outpatient disease visits in the cohort study. The additional eight categories which did not fit the broader classification scheme are also shown together. Together, these visits accounted for 13.8% of total visits in the population.

Tobacco abuse had a small statistically significant impact on frequency of visits for administrative and social admission. It had a slightly negative correlation with visits for examinations and screening, and a larger negative correlation with visits for ophthalmologic conditions.

Of the seven categories in the musculoskeletal grouping of diseases, tobacco use had no statistically significant effect on two categories (232 and 254), a small

positive correlation with one category (205), and modest negative correlation on four categories (211, 204, 225, and 212).

Of the five categories grouped in the respiratory category, tobacco had a strong negative correlation with one category (134), a weak negative correlation with two others (126 and 253), no statistically significant effect on one (7), and a weak positive correlation on one (94).

Five disease codes were categorized under the broader group of behavioral and psychiatric diseases. Here the results all showed a strong positive correlation between tobacco use and all disease categories. The linkage between tobacco use and category 66, alcohol related mental disorders, with an adjusted odds ratio of 3.31 (CI 3.02 to 3.63) was especially noteworthy.

The final grouping contained diagnostic categories that did not fit in the other six groupings. Tobacco had a negative correlation with frequency of five codes (257, 200, 175, 176, and 84), no statistically significant effect on two codes (196 and 58), and a weak positive effect on one category (259).

DISCUSSION

Findings

Expected Results

We had expected to see a positive correlation between tobacco use and outpatient clinic visits, similar to the results that Robbins described. We hypothesized that a positive correlation would exist between tobacco use and disease categories where clear causal pathophysiological relationships exist, such as in respiratory disease. We had also expected to see a correlation between tobacco use and co-morbid conditions such as the behavioral conditions. We had expected to see no positive relationship between tobacco use and conditions where no causality or co-morbid relationships exist.

We had expected to see higher mean numbers of visits for tobacco users (both male and female) than their non-tobacco using counterparts. However, this relationship was not a consistent finding. Similarly, because tobacco use has a negative effect on VO2 max, one would have predicted a higher percentage of non-tobacco users having a passing score on the fitness test, but this expected relationship did not apply, either.

Tobacco Use and Administrative, Examination and Screening Visits

These two categories together represented 20.8% of total visits in the cohort population. Clinic visits for these categories would not be expected to be increased

by tobacco use. The results of this study confirm that tobacco use had minimal effect on these diagnostic categories.

Tobacco Use and Ophthalmologic Conditions

Most of the visits coded in this group were for "Blindness and vision defects" (89). Many visits categorized in this group likely represent optometry evaluations and lens prescriptions. The additional category "Other eye disorders", (91) would contain a majority of ocular pathology, but this is a less common category. Tobacco use would not predict an increase in visits for these acute conditions based on pathophysiological mechanisms. In fact, there was a negative association between tobacco use and these two categories.

Tobacco Use and Musculoskeletal Disease

The largest category of disease was musculoskeletal, accounting for over 19% of all outpatient visits during the study period. While the American Academy of Orthopaedic Surgeons (AAOS) strongly recommended avoidance of tobacco due to a "severe and negative impact on the musculoskeletal system," most of the outcomes justifying this statement related to chronic diseases (rheumatoid arthritis, osteoporosis, osteopenia, and low back pain) or perioperative morbidity (American Academy of Orthopaedic Surgeons, 2001). This effect was attributed to generalized decreased blood flow from nicotine, and would explain why orthopedic patients who smoke have slower wound healing and post operative bone union than non-smokers. While the AAOS's position reflects good clinical advice, it appears to have limited relevance to reducing short term morbidity in a young outpatient

population. While acute musculoskeletal illness and injury were common in this population, chronic orthopedic problems were not. Only category 205 (spondylosis, intervertebral disc disorders, other back disorders), where tobacco had a slight positive correlation, was addressed directly by the AAOS position statement. Tobacco use appeared to have minimal or no effect on other musculoskeletal categories (232, 211, 204, 225, 212, and 254) in this study.

Tobacco Use and Respiratory Disease

Respiratory illness represents the second largest contributor to outpatient clinic visits in this population. The five categories (89, 91, 7, 94, and 253) which contained respiratory diagnoses (which included category 94, "Other ear and sense organ disorders" and category 7, viral infection) collectively accounted for 11.41% of all outpatient visits in this study. The evidence of tobacco as a causal factor in respiratory illness is strong in the literature. This causal relationship was first documented with chronic conditions such as lung cancer and chronic obstructive pulmonary disease. In 1990, the Surgeon General's report stated that "since the 1950's, strong evidence has accumulated documenting increased respiratory symptoms in smokers of all ages compared with non smokers (U.S. Department of Health And Human Services, 1990)" Because the association between respiratory disease and tobacco use is epidemiologically supported and consistent with known

pathophysiological mechanisms, one would have expected to see a strong relationship in this study.

Of the five codes related to the respiratory system described in this study, only category 94, "Other ear and sense organ disturbances," showed a modest positive correlation between tobacco use and this category. Three of the categories (126, "Other upper respiratory infections," 134, "Other upper respiratory disease," and 253, "Allergic reactions") actually showed an unexpected and statistically significant decrease in usage related to tobacco use.

Several possibilities exist to explain this outcome. First, tobacco use could actually confer a protective effect for respiratory illness in this population. Because this theory would dispute a fifty year body of literature and makes no epidemiologic or biologic sense, it should be rejected.

More likely is that tobacco users in this military population do have a higher frequency of respiratory symptoms and illness as predicted by the Surgeon General's reports. However, these symptoms are not strongly linked to care seeking behavior in this population, which would tend to underestimate the effects of tobacco. For example, a tobacco user may be more likely to attribute any respiratory illness or symptom to tobacco (the "smoker's cough"), and not seek the care of a physician as early or as often as their non-tobacco using counterparts. Knowing that tobacco cessation is a politically charged prevention program on many bases, they

might also avoid the physician's office if they anticipate a tobacco cessation lecture. Either way, pathophysiological mechanisms coupled with a compelling body of epidemiologic evidence linking tobacco use with respiratory symptoms and illness predicted an increase of respiratory illness in smokers. This effect was not seen in this study.

Tobacco Use and Behavioral Conditions

The third most common grouping was related to mental health and behavioral conditions, including alcohol related mental disorders. Epidemiological studies clearly show a strong relationship between alcohol use and abuse and tobacco use, which is most likely genetically, neuro-chemically, and environmentally linked, and experimental evidence does seem to implicate alcohol use as a cause of increasing tobacco use (Anthony & Echeagaray-Wagner, 2000). Therefore, alcohol and tobacco are co-morbid addictive behaviors, and a certain subset of the population is at risk of developing both (Hall, Lynskey, & Teesson, 2001). This literature would predict a strong correlation between tobacco use and alcohol related mental conditions (category 66). This association, with an odds ratio of 3.31 (CI 3.02 to 3.63) was the strongest relationship between tobacco use and any outpatient disease category.

Other research points to co-morbidity between all psychiatric illnesses and tobacco use. Mood disorders, anxiety disorders, and other psychiatric diagnosis

frequently co-exist with drugs of abuse, including alcohol and nicotine (Hall, Lynskey, & Teesson, 2001). The dopamine system is strongly implicated in mood and anxiety disorders, and emerging research suggests that some smokers may use nicotine to self-medicate mental health related illnesses (Miyasato, 2001). This may explain the success that using medications such as Buproprion, originally marketed as antidepressant, for tobacco cessation. Thus, while there is not convincing evidence that tobacco causes psychiatric illness, there are plausible genetic, environmental, behavioral and neurochemical associations between tobacco use and these other co-morbid conditions.

These strong associations were apparent in the reported results. The five psychiatric or behavioral diagnoses (66, 69, 72, 74, & 75) contained in the thirty diagnoses studied represented the strongest relationships between tobacco use and any disease category in this study.

Relationships Between Tobacco and Other Variables

In the other eight disease categories, which made up 13.8% of total visits, several categories (257, 200, 175, 176, and 84) showed a statistically significant negative association with tobacco use. Only one category (259, Residual codes unclassified) showed a statistically significant positive relationship with tobacco use. No chemical mechanisms would expect tobacco to be protective for this variety of conditions. Therefore, one would postulate that tobacco use was associated with

different patterns of care seeking behavior in members of this population who sought care for conditions in these diagnostic categories.

Study Limitations

Selection Bias

Of the approximately 350,087 active duty Air Force personnel on duty at the beginning of the study period, 245,308 (70.1%) were included in the cohort analysis. While individuals were excluded who lacked valid responses to the independent or dependent variables, or who were not on continuous duty during the study period, no attempt was made to sample except for the decision to exclude general officers. Their numbers were small, however, and could be expected to behave as a group much like that of senior colonels who were well represented in the study. Therefore, this potential selection bias likely had a negligible effect on results.

Members were also excluded who fell outside of the Air Force regulations for initial enlistment for height minimums and maximums. Because these standards may be waived on a case by case basis, some individuals who had valid responses were excluded in an effort to eliminate all invalid responses. In the same way, the decision to exclude individuals with the highest and lowest 0.01% of body weight removed some valid responses while eliminating many clearly irregular values. Therefore, this study may be generalized only to members who fell within these parameters. However, the small numbers of individuals removed would not be expected to change the final results

Effects of Exclusion Criteria on the Study

These exclusion criteria applied by the primary investigator eliminated less than 1% of the study population from the original data set. When the top 30 rank ordered diagnosis were calculated, there was no significant difference in ordering or percentage between the original and excluded cohorts. Therefore, this exclusion would be expected to have minimal effect on the final data interpretation.

Sampling Error

To minimize the potential for sampling error, all members who met the above criteria were included in the study design. One might predict that tobacco users might preferentially chose not to take the fitness test for fear of failing. Further, one may also predict that military members may have feared reprisal for tobacco use, and avoided truthful reporting of tobacco use. However, the initial data set contained 28.8% tobacco users based upon the questionnaires, which is only slightly lower (29.9%) than Bray reported in a similar military population in 1998. If any underreporting did actually occur in this study, it was minimal and its effect would not be expected to significantly affect the final results.

Measurement Error

The data for performance on the fitness test, height, weight, and body mass index were subject to measurement error. Use of exclusion criteria eliminated many invalid responses but also removed a small but undetermined number of valid responses. Even with these exclusion criteria, values that were incorrectly measured

but which fell within the inclusion limits were analyzed. This error would most likely show no preference for tobacco users or non-users and thus should not impact final data analysis.

Classification Error of Confounding Variables

Potential misclassification error also existed for the confounding variables of age, sex, race, and rank. Because classification of these variables would be independent of self-reported tobacco use, this potential misclassification would not be expected to significantly impact the measures of tobacco related illness.

Finally, the questionnaire made no allowances for recently changing tobacco use patterns. Tobacco status was captured in the fitness questionnaire, and ex-tobacco users were categorized the same as non-users. These ex-users would be expected to have an intermediate level of disease. Grouping non-users and ex-users together would tend to increase the incidence of disease in the referent group, and minimize the apparent contribution of tobacco to these disease categories.

Potential Classification Errors of Dependent Variable

The most problematic source of misclassification error existed in the collection and reporting of ICD-9 coded outpatient visits in the military medical system. In the civilian health care delivery system, coding has been used for many years to make reimbursement and staffing decisions. One would expect mature and accurate data collection systems in managed care organizations. Even so, such data collection is often inaccurate. For example, the Department of Veteran's Affairs, an

organization with a long history of data collection, reported an over-all 65% concordance of primary discharge diagnosis from inpatient visits. Even among expert coders, they reported a 19% discrepancy in primary diagnoses coded (Department Of Veteran's Affairs, 1993). One would expect that outpatient coding would be even less accurate because it is done in a less controlled environment.

In the active duty military health care system, incentives for accurate coding based on reimbursement and threats of litigation have only recently appeared. Therefore, a less developed data collection system exists. Anecdotal evidence by the primary investigator suggests that coding decisions at military installations has frequently been an additional responsibility of the physician staff, a group which may focus little effort or time in accurate coding. In such a system, accuracy may likely be less important than coding completion to the physician, and data collected in such a way would be expected to have many errors. These errors should be independent of the patient's tobacco status or other demographic data.

Finally, grouping categories 7 (Viral infection) and 253 (Allergic reactions) into the broader category respiratory illness introduces a potential classification error because not all viral infections and allergic reactions are respiratory. While the effect of tobacco on these disease categories is small, care must be taken when considering them together with other respiratory illnesses.

Limitations of Methods

The original study design included the performance on the fitness test as a confounding variable because it was the only accessible variable which could be correlated with exercise patterns and overall physical fitness. However, tobacco use can also affect VO2 max, introducing the possibility that performance on the fitness test could represent both an independent confounding variable and a dependent outcome variable when evaluating cohorts defined by smoking status. Because it was the only surrogate for overall fitness and exercise patterns, it was left in the regression models. Inclusion of this variable did introduce the risk of a potential error.

The decision to treat the outcome variable as dichotomous (yes/no) for the purpose of regression models represents a potential limitation. Members of the exposure group who sought care for a particular disease category may then utilize care differently than a member in the reference group. For example, if tobacco users were sicker than non tobacco users for a particular condition, they would be expected to generate more repeat visits for the same condition. Such differences would have an effect on health care utilization and morbidity. With this study design, these patterns would not be apparent in this population.

Applications to Other Populations

In this population, males, Caucasians, younger and junior ranking individuals self reported higher tobacco use rates. This mirrors national trends

reported by the Substance Abuse and Mental Health Services Administration, which show higher use in males and Caucasians when compared to those with an African American background, and a general decline in cigarette usage from a peak in the early 20's. While no direct equivalent to military rank exists in the civilian literature, rank may be viewed as an indicator of socioeconomic status. Members with higher rank tend to have achieved higher levels of formal education and have a higher family income than the junior members of the military. Both education and family income are associated nationally with decreasing prevalence of tobacco use nationally (Substance Abuse and Mental Health Services Administration, 2002). Therefore, in many respects the tobacco use patterns in the Air Force population studied is similar to the general population of the United States.

Data from the National Household Survey on Drug Abuse in 1999 showed an estimated 30.2% of Americans aged 12 or older identified any tobacco use in the past month (Substance Abuse and Mental Health Services Administration, 2002). This value was slightly higher than that reported (28.8%) by the Air Force population in this study. While the study designs and data collection methods were different, the data in the Air Force cohort study may be rearranged to approximate the patterns of tobacco use reported in the SAMSHA report. The Air Force population shows a similar pattern of type of tobacco product used. Cigarettes account for the majority

of tobacco use in both populations, while smokeless tobacco, pipe, and cigar usage are all have significantly lower rates.

Table 5

Comparison between 1999 SAMHSA data on tobacco usage in past month and self reported tobacco use in this 2001 USAF Cohort

	1999 US population Tobacco use in past month	2001 Air Force Cohort Self identified tobacco use
Tobacco use	30.2%	28.8%
Cigarettes	25.8	23.3
Smokeless	3.4	5.3
Cigars	5.5	
Pipes	1.1	
Pipes/Cigars		2.23

Therefore, as described in Table 5 and the demographic descriptions from the 1999 SAMHSA study, tobacco use characteristics and patterns in the cohort population are similar to the population of the United States as a whole.

While this cohort study population was a relatively young and healthy one, they utilized medical appointments more often than an adult civilian managed care population (Tuso, Murtishaw, & Tadros, 1999). This may be partly due to the unique mission driven requirements of military service including occupational and administrative functions, but is also likely due to the low cost and easy access that

medical care represents to the active duty Air Force member compared to his or her civilian counterpart. Previous studies have shown a correlation between low cost and high clinic usage, which is a likely source of this behavior in the cohort population (Newhouse, 1995)

Thus, this study population and the adult American population as a whole shared many demographic and tobacco related behavioral patterns. However, the two populations differ substantially in source of medical care, so care must be taken if attempting to generalize findings in this study to a nonmilitary population.

Implications for Further Research

As described above, the decision to treat the dependent variable in each regression model as a dichotomous (yes/no) response was a potential limitation because different patterns of behavior between exposure and referent groups would not be noted. Future study could compare the patterns of outpatient visit utilization for tobacco users and the referent group who sought care for each condition. This would be done by calculating distributions for the exposure and referent group for each of the thirty diagnostic categories, and comparing the distributions for differences.

Including alcohol use as a confounding variable would be appropriate because of the strong relationship between tobacco use and alcohol related illness seen in this study. Unfortunately, current military data bases do not have an

accessible and accurate classification of alcohol use in this population, so this study would not be possible using secondary data sources.

Another valuable study would repeat this study using the same data base, exclusion criteria, and logistics models. However, instead of ranking the thirty most common outpatient disease categories and performing thirty regression models, one could group the codes into the broader categories such as respiratory, musculoskeletal, and psychiatric prior to analysis. Logistics regression models could be applied to these combined categories, allowing the researcher to discuss tobacco's relationship with grouped diagnoses.

One could also use the same data base and exclusion criteria to repeat Robbins' study to determine if his results could be generalized to the larger population in this study, which one would expect.

The strength of association between tobacco use and some psychiatric and behavioral conditions, most notably alcohol related mental disorders (66), was high. One could hypothesize that the increased population attributable risk fraction associated with tobacco use that Robbins described may be due to co-morbid psychiatric and behavioral diagnoses. This could be tested by removing these diagnoses and repeating the regression models.

Finally, this data set represents a valuable picture of the United States Air Force active duty population during the study period and contains many interesting

relationships between the variables studied. It should be explored more fully to generate and test other hypotheses.

CONCLUSIONS

Tobacco use has been described as the most important avoidable health risk behavior in the American population. Tobacco use increases both costs and morbidity of chronic disease in our population, and is thus an important public health problem.

Tobacco is also important to the United States military, where the costs of caring for chronic diseases are great and rising. The impact that tobacco has on morbidity and costs in a young healthy military population is less well studied. Previous studies have described these effects and estimated tobacco related direct and indirect costs in a military population with mixed results. This study continued this exploration into the effects of tobacco use in a young military population.

Using a retrospective cohort design, this study described the relationships between tobacco and common outpatient disease categories in an Air Force active duty population. It controlled for age, sex, race, rank, body mass index, and performance on a fitness test in two exposure groups based upon self identified tobacco use. Tobacco use was expected to be related to an increase utilization of medical care for groups of conditions where tobacco was either causally or co-morbidly related, and show no increase in groups of diseases where tobacco has not been associated.

The results of the study were mixed. Tobacco use was shown to be a strong independent predictor of utilization of medical care for co-morbid behavioral and psychiatric diagnoses, but was not a predictor for increased utilization due to musculoskeletal or other diagnostic categories. However, tobacco did not show any increase in utilization of disease categories for respiratory illness, which would have been predicted based upon epidemiologic literature and pathophysiologic explanations. These unexpected results need to be further studied to better explain the important health effects that tobacco has on a young military population.

APPENDICES

Appendix 1: Selected Tobacco Related Reports of the U.S. Surgeon General

1964 Smoking and Health: Report of the Advisory Committee of the Surgeon General of the Public Health Service

1977/1978
The Health Consequences of Smoking

1980 The Health Consequences of Smoking for Women: A Report of the Surgeon General

1981 The Health Consequences of Smoking- The Changing Cigarette: A Report of the Surgeon General

1982 The Health Consequences of Smoking- Cancer: A Report of the Surgeon General

1983 The Health Consequences of Smoking- Cardiovascular Disease: A Report of the Surgeon General

1984 The Health Consequences of Smoking- Chronic Obstructive Lung Disease: A Report of the Surgeon General

1985 The Health Consequences of Smoking- Cancer and Chronic Lung Disease in the Workplace: A Report of the Surgeon General

1986 The Health Consequences of Involuntary Smoking: A Report of the Surgeon General

1988 The Health Consequences of Smoking- Nicotine Addiction: A Report of the Surgeon General

1989 Reducing the Health Consequences of Smoking- 25 Years of Progress: A Report of the Surgeon General

1990 The Health Benefits of Smoking Cessation: A Report of the Surgeon General

1992 Smoking and Health in the Americas: A Report of the Surgeon General

1994 Preventing Tobacco Use Among Young People: A Report of the Surgeon General
Surgeon General's Report for Kids about Smoking

1998 Tobacco Use Among U.S. Racial/Ethnic Minority Groups: A Report of the Surgeon General

2000 Reducing Tobacco Use: A Report of the Surgeon General

A complete list of downloadable copies or links to the Surgeon General's Reports can be found at **http://www.surgeongeneral.gov/library/reports.htm**

Appendix 2: Diagnostic Categories from AHQR CCS

1 Tuberculosis
2 Septicemia (except in labor)
3 Bacterial infection, unspecified site
4 Mycoses
5 HIV infection
6 Hepatitis
7 Viral infection
8 Other infections, including parasitic
9 Sexually transmitted infections (not HIV or hepatitis)
10 Immunizations and screening for infectious disease
11 Cancer of head and neck
12 Cancer of esophagus
13 Cancer of stomach
14 Cancer of colon
15 Cancer of rectum and anus
16 Cancer of liver and intrahepatic bile duct
17 Cancer of pancreas
18 Cancer of other GI organs, peritoneum
19 Cancer of bronchus, lung
20 Cancer, other respiratory and intrathoracic
21 Cancer of bone and connective tissue
22 Melanomas of skin
23 Other non-epithelial cancer of skin
24 Cancer of breast
25 Cancer of uterus
26 Cancer of cervix
27 Cancer of ovary
28 Cancer of other female genital organs
29 Cancer of prostate
30 Cancer of testis
31 Cancer of other male genital organs
32 Cancer of bladder
33 Cancer of kidney and renal pelvis
34 Cancer of other urinary organs
35 Cancer of brain and nervous system
36 Cancer of thyroid
37 Hodgkin's disease
38 Non-Hodgkin's lymphoma
39 Leukemias
40 Multiple myeloma

41 Cancer, other and unspecified primary
42 Secondary malignancies
43 Malignant neoplasm without specification of site
44 Neoplasms of unspecified nature or uncertain behavior
45 Maintenance chemotherapy, radiotherapy
46 Benign neoplasm of uterus
47 Other and unspecified benign neoplasm
48 Thyroid disorders
49 Diabetes mellitus without complication
50 Diabetes mellitus with complications
51 Other endocrine disorders
52 Nutritional deficiencies
53 Disorders of lipid metabolism
54 Gout and other crystal arthropathies
55 Fluid and electrolyte disorders
56 Cystic fibrosis
57 Immunity disorders
58 Other nutritional, endocrine, and metabolic disorders
59 Deficiency and other anemia
60 Acute posthemorrhagic anemia
61 Sickle cell anemia
62 Coagulation and hemorrhagic disorders
63 Diseases of white blood cells
64 Other hematologic conditions
65 Mental retardation
66 Alcohol-related mental disorders
67 Substance-related mental disorders
68 Senility and organic mental disorders
69 Affective disorders
70 Schizophrenia and related disorders
71 Other psychoses
72 Anxiety, somatoform, dissociative, and personality disorders
73 Preadult disorders
74 Other mental conditions
75 Personal history of mental disorder, mental and behavioral problems, observation and screening for mental condition
76 Meningitis (except that caused by tuberculosis or sexually transmitted disease)
77 Encephalitis (except that caused by tuberculosis or sexually transmitted disease)
78 Other CNS infection and poliomyelitis
79 Parkinson's disease
80 Multiple sclerosis
81 Other hereditary and degenerative nervous system conditions
82 Paralysis

83 Epilepsy, convulsions
84 Headache, including migraine
85 Coma, stupor, and brain damage
86 Cataract
87 Retinal detachments, defects, vascular occlusion, and retinopathy
88 Glaucoma
89 Blindness and vision defects
90 Inflammation, infection of eye (except that caused by tuberculosis or sexually transmitted disease)
91 Other eye disorders
92 Otitis media and related conditions
93 Conditions associated with dizziness or vertigo
94 Other ear and sense organ disorders
95 Other nervous system disorders
96 Heart valve disorders
97 Peri-, endo-, and myocarditis, cardiomyopathy (except that caused by tuberculosis or sexually transmitted disease)
98 Essential hypertension
99 Hypertension with complications and secondary hypertension
100 Acute myocardial infarction
101 Coronary atherosclerosis and other heart disease
102 Nonspecific chest pain
103 Pulmonary heart disease
104 Other and ill-defined heart disease
105 Conduction disorders
106 Cardiac dysrhythmias
107 Cardiac arrest and ventricular fibrillation
108 Congestive heart failure, nonhypertensive
109 Acute cerebrovascular disease
110 Occlusion or stenosis of precerebral arteries
111 Other and ill-defined cerebrovascular disease
112 Transient cerebral ischemia
113 Late effects of cerebrovascular disease
114 Peripheral and visceral atherosclerosis
115 Aortic, peripheral, and visceral artery aneurysms
116 Aortic and peripheral arterial embolism or thrombosis
117 Other circulatory disease
118 Phlebitis, thrombophlebitis and thromboembolism
119 Varicose veins of lower extremity
120 Hemorrhoids
121 Other diseases of veins and lymphatics
122 Pneumonia (except that caused by tuberculosis or sexually transmitted disease)
123 Influenza

124 Acute and chronic tonsillitis
125 Acute bronchitis
126 Other upper respiratory infections
127 Chronic obstructive pulmonary disease and bronchiectasis
128 Asthma
129 Aspiration pneumonitis, food/vomitus
130 Pleurisy, pneumothorax, pulmonary collapse
131 Respiratory failure, insufficiency, arrest (adult)
132 Lung disease due to external agents
133 Other lower respiratory disease
134 Other upper respiratory disease
135 Intestinal infection
136 Disorders of teeth and jaw
137 Diseases of mouth, excluding dental
138 Esophageal disorders
139 Gastroduodenal ulcer (except hemorrhage)
140 Gastritis and duodenitis
141 Other disorders of stomach and duodenum
142 Appendicitis and other appendiceal conditions
143 Abdominal hernia
144 Regional enteritis and ulcerative colitis
145 Intestinal obstruction without hernia
146 Diverticulosis and diverticulitis
147 Anal and rectal conditions
148 Peritonitis and intestinal abscess
149 Biliary tract disease
150 Liver disease, alcohol-related
151 Other liver diseases
152 Pancreatic disorders (not diabetes)
153 Gastrointestinal hemorrhage
154 Noninfectious gastroenteritis
155 Other gastrointestinal disorders
156 Nephritis, nephrosis, renal sclerosis
157 Acute and unspecified renal failure
158 Chronic renal failure
159 Urinary tract infections
160 Calculus of urinary tract
161 Other diseases of kidney and ureters
162 Other diseases of bladder and urethra
163 Genitourinary symptoms and ill-defined conditions
164 Hyperplasia of prostate
165 Inflammatory conditions of male genital organs
166 Other male genital disorders
167 Nonmalignant breast conditions

168 Inflammatory diseases of female pelvic organs
169 Endometriosis
170 Prolapse of female genital organs
171 Menstrual disorders
172 Ovarian cyst
173 Menopausal disorders
174 Female infertility
175 Other female genital disorders
176 Contraceptive and procreative management
177 Spontaneous abortion
178 Induced abortion
179 Postabortion complications
180 Ectopic pregnancy
181 Other complications of pregnancy
182 Hemorrhage during pregnancy, abruptio placenta, placenta previa
183 Hypertension complicating pregnancy, childbirth and the puerperium
184 Early or threatened labor
185 Prolonged pregnancy
186 Diabetes or abnormal glucose tolerance complicating pregnancy, childbirth, or the puerperium
187 Malposition, malpresentation
188 Fetopelvic disproportion, obstruction
189 Previous C-section
190 Fetal distress and abnormal forces of labor
191 Polyhydramnios and other problems of amniotic cavity
192 Umbilical cord complication
193 Trauma to perineum and vulva
194 Forceps delivery
195 Other complications of birth, puerperium affecting management of mother
196 Normal pregnancy and/or delivery
197 Skin and subcutaneous tissue infections
198 Other inflammatory condition of skin
199 Chronic ulcer of skin
200 Other skin disorders
201 Infective arthritis and osteomyelitis (except that caused by tuberculosis or sexually transmitted disease)
202 Rheumatoid arthritis and related disease
203 Osteoarthritis
204 Other non-traumatic joint disorders
205 Spondylosis, intervertebral disc disorders, other back problems
206 Osteoporosis
207 Pathological fracture
208 Acquired foot deformities
209 Other acquired deformities

210 Systemic lupus erythematosus and connective tissue disorders
211 Other connective tissue disease
212 Other bone disease and musculoskeletal deformities
213 Cardiac and circulatory congenital anomalies
214 Digestive congenital anomalies
215 Genitourinary congenital anomalies
216 Nervous system congenital anomalies
217 Other congenital anomalies
218 Liveborn
219 Short gestation, low birth weight, and fetal growth retardation
220 Intrauterine hypoxia and birth asphyxia
221 Respiratory distress syndrome
222 Hemolytic jaundice and perinatal jaundice
223 Birth trauma
224 Other perinatal conditions
225 Joint disorders and dislocations, trauma-related
226 Fracture of neck of femur (hip)
227 Spinal cord injury
228 Skull and face fractures
229 Fracture of upper limb
230 Fracture of lower limb
231 Other fractures
232 Sprains and strains
233 Intracranial injury
234 Crushing injury or internal injury
235 Open wounds of head, neck, and trunk
236 Open wounds of extremities
237 Complication of device, implant or graft
238 Complications of surgical procedures or medical care
239 Superficial injury, contusion
240 Burns
241 Poisoning by psychotropic agents
242 Poisoning by other medications and drugs
243 Poisoning by nonmedicinal substances
244 Other injuries and conditions due to external causes
245 Syncope
246 Fever of unknown origin
247 Lymphadenitis
248 Gangrene
249 Shock
250 Nausea and vomiting
251 Abdominal pain
252 Malaise and fatigue
253 Allergic reactions

254 Rehabilitation care, fitting of prostheses, and adjustment of devices
255 Administrative/social admission
256 Medical examination/evaluation
257 Other aftercare
258 Other screening for suspected conditions (not mental disorders or infectious disease)
259 Residual codes, unclassified
260 E Codes: All (external causes of injury and poisoning)

Appendix 3: Regression Models for Thirty Disease Categories in Study

Rank	Code	Variable	Estimated Beta Coefficient	Estimated S.E.	P-Value	Odds Ratio	95% Confidence Limits	
1	255	Administrative/Social Admission						
		Tobacco Use	0.0215	0.0096	0.0255	1.022	1.003	1.041
		Age	-0.0031	0.0007	<.0001	0.997	0.995	0.998
		Sex	-0.7030	0.0113	<.0001	0.495	0.484	0.506
		Race African American	-0.0452	0.0117	0.0001	0.956	0.934	0.978
		Other	-0.1020	0.0157	<.0001	0.903	0.876	0.931
		Military Rank E7-E9	-0.0011	0.0168	0.9500	0.999	0.967	1.032
		O1-O3	0.0141	0.0138	0.3095	1.014	0.987	1.042
		O4-O6	-0.0007	0.0196	0.9715	0.999	0.962	1.038
		BMI	0.0313	0.0014	<.0001	1.032	1.029	1.035
		Fitness Test Indeterminate	0.0176	0.0181	0.3305	1.018	0.982	1.055
		Fail	0.0330	0.0099	0.0008	1.034	1.014	1.054
2	256	Medical examination/evaluation						
		Tobacco Use	-0.0254	0.0096	0.0085	0.975	0.957	0.994
		Age	-0.0036	0.0007	<.0001	0.996	0.995	0.998
		Sex	-0.0367	0.0115	0.0014	0.964	0.943	0.986
		Race African American	-0.1280	0.0118	<.0001	0.880	0.860	0.900
		Other	-0.0610	0.0157	<.0001	0.941	0.912	0.970
		Military Rank E7-E9	0.0336	0.0169	0.0464	1.034	1.001	1.069
		O1-O3	0.1834	0.0137	<.0001	1.201	1.170	1.234
		O4-O6	0.3279	0.0193	<.0001	1.388	1.337	1.442
		BMI	0.0132	0.0014	<.0001	1.013	1.011	1.016
		Fitness Test Indeterminate	-0.0093	0.0182	0.6091	0.991	0.956	1.027
		Fail	-0.0076	0.0099	0.4437	0.992	0.973	1.012
3	126	Other upper respiratory infections						
		Tobacco Use	-0.0270	0.0111	0.0145	0.973	0.953	0.995
		Age	-0.0167	0.0009	<.0001	0.983	0.982	0.985
		Sex	-0.6553	0.0122	<.0001	0.519	0.507	0.532
		Race African American	-0.1687	0.0136	<.0001	0.845	0.822	0.868
		Other	-0.0275	0.0177	0.1199	0.973	0.940	1.007
		Military Rank E7-E9	-0.0540	0.0205	0.0084	0.947	0.910	0.986
		O1-O3	0.1572	0.0154	<.0001	1.170	1.135	1.206
		O4-O6	0.1236	0.0229	<.0001	1.132	1.082	1.183
		BMI	0.0097	0.0016	<.0001	1.010	1.007	1.013
		Fitness Test Indeterminate	-0.0305	0.0206	0.1390	0.970	0.931	1.010
		Fail	-0.0303	0.0115	0.0086	0.970	0.948	0.992

Continued on Next Page

Appendix 3 (Continued)

Rank	Code	Variable	Estimated Beta Coefficient	Estimated S.E.	P-Value	Odds Ratio	95% Confidence Limits	
4	89	Blindness and vision defects						
		Tobacco Use	-0.1853	0.0120	<.0001	0.831	0.812	0.851
		Age	0.0211	0.0009	<.0001	1.021	1.020	1.023
		Sex	-0.5460	0.0128	<.0001	0.579	0.565	0.594
		Race African American	-0.0654	0.0141	<.0001	0.937	0.911	0.963
		Other	0.1711	0.0180	<.0001	1.187	1.145	1.229
		Military Rank E7-E9	0.2016	0.0191	<.0001	1.223	1.179	1.270
		O1-O3	0.3073	0.0156	<.0001	1.360	1.319	1.402
		O4-O6	0.3304	0.0216	<.0001	1.392	1.334	1.452
		BMI	-0.0064	0.0017	0.0001	0.994	0.990	0.997
		Fitness Test Indeterminate	0.0085	0.0211	0.6862	1.009	0.968	1.051
		Fail	0.0018	0.0119	0.8828	1.002	0.979	1.025
5	205	Spondylosis, intervertebral disc disorders, other back disorders						
		Tobacco Use	0.0319	0.0154	0.0384	1.032	1.002	1.064
		Age	0.0327	0.0012	<.0001	1.033	1.031	1.036
		Sex	-0.4869	0.0173	<.0001	0.615	0.594	0.636
		Race African American	-0.0683	0.0186	0.0002	0.934	0.901	0.969
		Other	-0.1248	0.0265	<.0001	0.883	0.838	0.930
		Military Rank E7-E9	0.0323	0.0240	0.1794	1.033	0.985	1.083
		O1-O3	-0.4907	0.0255	<.0001	0.612	0.582	0.644
		O4-O6	-0.5198	0.0317	<.0001	0.595	0.559	0.633
		BMI	0.0183	0.0022	<.0001	1.018	1.014	1.023
		Fitness Test Indeterminate	-0.0609	0.0289	0.0348	0.941	0.889	0.996
		Fail	-0.0452	0.0159	0.0044	0.956	0.926	0.986
6	232	Sprains and strains						
		Tobacco Use	-0.0199	0.0142	0.1632	0.980	0.953	1.008
		Age	-0.0059	0.0011	<.0001	0.994	0.992	0.996
		Sex	-0.0495	0.0171	0.0037	0.952	0.920	0.984
		Race African American	0.1102	0.0168	<.0001	1.117	1.080	1.154
		Other	-0.0136	0.0235	0.5634	0.987	0.942	1.033
		Military Rank E7-E9	-0.0150	0.0251	0.5483	0.985	0.938	1.035
		O1-O3	-0.3526	0.0228	<.0001	0.703	0.672	0.735
		O4-O6	-0.3432	0.0320	<.0001	0.709	0.666	0.755
		BMI	0.0322	0.0021	<.0001	1.033	1.029	1.037
		Fitness Test Indeterminate	-0.0942	0.0276	0.0006	0.910	0.862	0.961
		Fail	-0.1787	0.0151	<.0001	0.836	0.812	0.862

Continued on Next Page

Appendix 3 (Continued)

Rank	Code	Variable	Estimated Beta Coefficient	Estimated S.E.	P-Value	Odds Ratio	95% Confidence Limits	
7	211	Other connective tissue disease						
		Tobacco Use	-0.1170	0.0156	<.0001	0.890	0.863	0.917
		Age	0.0357	0.0011	<.0001	1.036	1.034	1.039
		Sex	-0.4173	0.0172	<.0001	0.659	0.637	0.681
		Race African American	0.0276	0.0178	0.1210	1.028	0.993	1.065
		Other	-0.0738	0.0257	0.0041	0.929	0.883	0.977
		Military Rank E7-E9	0.0311	0.0233	0.1824	1.032	0.986	1.080
		O1-O3	-0.4010	0.0241	<.0001	0.670	0.639	0.702
		O4-O6	-0.3925	0.0296	<.0001	0.675	0.637	0.716
		BMI	0.0332	0.0022	<.0001	1.034	1.029	1.038
		Fitness Test Indeterminate	-0.0909	0.0283	0.0013	0.913	0.864	0.965
		Fail	-0.1340	0.0157	<.0001	0.875	0.848	0.902
8	257	Other aftercare						
		Tobacco Use	-0.0308	0.0148	0.0375	0.970	0.942	0.998
		Age	0.0035	0.0011	0.0019	1.003	1.001	1.006
		Sex	-0.4271	0.0162	<.0001	0.652	0.632	0.673
		Race African American	-0.1172	0.0180	<.0001	0.889	0.859	0.921
		Other	-0.1433	0.0245	<.0001	0.867	0.826	0.909
		Military Rank E7-E9	0.0730	0.0252	0.0038	1.076	1.024	1.130
		O1-O3	0.2462	0.0197	<.0001	1.279	1.231	1.330
		O4-O6	0.2267	0.0281	<.0001	1.254	1.187	1.325
		BMI	0.0173	0.0021	<.0001	1.017	1.013	1.022
		Fitness Test Indeterminate	0.0292	0.0266	0.2729	1.030	0.977	1.085
		Fail	-0.0455	0.0152	0.0027	0.955	0.927	0.984
9	204	Other non-traumatic joint disorders						
		Tobacco Use	-0.0430	0.0166	0.0096	0.958	0.927	0.990
		Age	0.0222	0.0012	<.0001	1.022	1.020	1.025
		Sex	-0.2732	0.0190	<.0001	0.761	0.733	0.790
		Race African American	0.0992	0.0191	<.0001	1.104	1.064	1.146
		Other	-0.0957	0.0282	0.0007	0.909	0.860	0.960
		Military Rank E7-E9	0.0342	0.0259	0.1879	1.035	0.983	1.089
		O1-O3	-0.4131	0.0267	<.0001	0.662	0.628	0.697
		O4-O6	-0.4731	0.0345	<.0001	0.623	0.582	0.667
		BMI	0.0371	0.0024	<.0001	1.038	1.033	1.043
		Fitness Test Indeterminate	-0.0311	0.0305	0.3090	0.969	0.913	1.029
		Fail	-0.1149	0.0170	<.0001	0.891	0.862	0.922

Continued on Next Page

Appendix 3 (Continued)

Rank	Code	Variable	Estimated Beta Coefficient	Estimated S.E.	P-Value	Odds Ratio	95% Confidence Limits	
10	200	Other skin disorders						
		Tobacco Use	-0.1089	0.0163	<.0001	0.897	0.869	0.926
		Age	-0.0181	0.0013	<.0001	0.982	0.980	0.984
		Sex	-0.4288	0.0170	<.0001	0.651	0.630	0.673
		Race African American	0.5546	0.0170	<.0001	1.741	1.684	1.800
		Other	0.1155	0.0254	<.0001	1.122	1.068	1.180
		Military Rank E7-E9	0.1384	0.0290	<.0001	1.148	1.085	1.216
		O1-O3	-0.1148	0.0241	<.0001	0.892	0.850	0.935
		O4-O6	0.2868	0.0328	<.0001	1.332	1.249	1.421
		BMI	-0.0044	0.0023	0.0544	0.996	0.991	1.000
		Fitness Test Indeterminate	-0.0860	0.0293	0.0033	0.918	0.866	0.972
		Fail	-0.1282	0.0169	<.0001	0.880	0.851	0.909
11	134	Other upper respiratory disease						
		Tobacco Use	-0.3117	0.0178	<.0001	0.732	0.707	0.758
		Age	0.0167	0.0013	<.0001	1.017	1.014	1.019
		Sex	-0.5105	0.0181	<.0001	0.600	0.579	0.622
		Race African American	-0.0697	0.0202	0.0006	0.933	0.896	0.970
		Other	0.1092	0.0260	<.0001	1.115	1.060	1.174
		Military Rank E7-E9	-0.0766	0.0283	0.0067	0.926	0.876	0.979
		O1-O3	-0.0988	0.0239	<.0001	0.906	0.864	0.949
		O4-O6	-0.2752	0.0338	<.0001	0.759	0.711	0.811
		BMI	-0.0044	0.0024	0.0721	0.996	0.991	1.000
		Fitness Test Indeterminate	-0.0577	0.0311	0.0635	0.944	0.888	1.003
		Fail	0.0087	0.0174	0.6167	1.009	0.975	1.044
12	175	Other female genital disorders						
		Tobacco Use	-0.1369	0.0236	<.0001	0.872	0.833	0.913
		Age	-0.0173	0.0017	<.0001	0.983	0.980	0.986
		Sex	-7.2159	0.0778	<.0001	<.001	<.001	<.001
		Race African American	0.0263	0.0233	0.2592	1.027	0.981	1.075
		Other	-0.0095	0.0328	0.7732	0.991	0.929	1.056
		Military Rank E7-E9	0.1329	0.0482	0.0058	1.142	1.039	1.255
		O1-O3	-0.0765	0.0312	0.0143	0.926	0.871	0.985
		O4-O6	0.0430	0.0509	0.3982	1.044	0.945	1.154
		BMI	-0.0224	0.0034	<.0001	0.978	0.971	0.984
		Fitness Test Indeterminate	0.0370	0.0324	0.2533	1.038	0.974	1.106
		Fail	-0.0335	0.0275	0.2241	0.967	0.916	1.021

Continued on Next Page

Appendix 3 (Continued)

Rank	Code	Variable	Estimated Beta Coefficient	Estimated S.E.	P-Value	Odds Ratio	95% Confidence Limits	
13	91	Other eye disorders						
		Tobacco Use	-0.1621	0.0159	<.0001	0.850	0.824	0.877
		Age	0.0167	0.0012	<.0001	1.017	1.015	1.019
		Sex	-0.4154	0.0169	<.0001	0.660	0.639	0.682
		Race African American	0.0160	0.0184	0.3840	1.016	0.980	1.053
		Other	0.1681	0.0236	<.0001	1.183	1.130	1.239
		Military Rank E7-E9	0.0549	0.0254	0.0310	1.056	1.005	1.110
		O1-O3	0.1013	0.0212	<.0001	1.107	1.062	1.153
		O4-O6	0.1281	0.0287	<.0001	1.137	1.074	1.203
		BMI	-0.0001	0.0022	0.9610	1.000	0.996	1.004
		Fitness Test Indeterminate	-0.0828	0.0286	0.0038	0.921	0.870	0.974
		Fail	-0.0150	0.0158	0.3418	0.985	0.955	1.016
14	176	Contraceptive and procreative management						
		Tobacco Use	-0.0636	0.0179	0.0004	0.938	0.906	0.972
		Age	-0.0114	0.0014	<.0001	0.989	0.986	0.991
		Sex	-1.6958	0.0169	<.0001	0.183	0.177	0.190
		Race African American	0.0104	0.0200	0.6032	1.010	0.972	1.051
		Other	-0.0824	0.0282	0.0035	0.921	0.871	0.973
		Military Rank E7-E9	-0.0007	0.0334	0.9845	0.999	0.936	1.067
		O1-O3	-0.2329	0.0268	<.0001	0.792	0.752	0.835
		O4-O6	-0.0668	0.0388	0.0850	0.935	0.867	1.009
		BMI	0.0091	0.0026	0.0004	1.009	1.004	1.014
		Fitness Test Indeterminate	-0.0155	0.0303	0.6081	0.985	0.928	1.045
		Fail	0.0366	0.0190	0.0534	1.037	0.999	1.077
15	225	Joint disorders and dislocations, trauma related						
		Tobacco Use	-0.0726	0.0266	0.0062	0.930	0.883	0.980
		Age	0.0145	0.0020	<.0001	1.015	1.011	1.019
		Sex	-0.0534	0.0321	0.0963	0.948	0.890	1.010
		Race African American	0.0539	0.0307	0.0792	1.055	0.994	1.121
		Other	-0.1326	0.0457	0.0037	0.876	0.801	0.958
		Military Rank E7-E9	-0.0146	0.0420	0.7280	0.985	0.908	1.070
		O1-O3	-0.3523	0.0423	<.0001	0.703	0.647	0.764
		O4-O6	-0.3928	0.0550	<.0001	0.675	0.606	0.752
		BMI	0.0525	0.0037	<.0001	1.054	1.046	1.062
		Fitness Test Indeterminate	-0.0457	0.0495	0.3559	0.955	0.867	1.053
		Fail	-0.1731	0.0273	<.0001	0.841	0.797	0.887

Continued on Next Page

Appendix 3 (Continued)

Rank	Code	Variable	Estimated Beta Coefficient	Estimated S.E.	P-Value	Odds Ratio	95% Confidence Limits	
16	7	Viral infection						
		Tobacco Use	-0.0221	0.0178	0.2150	0.978	0.945	1.013
		Age	-0.0349	0.0015	<.0001	0.966	0.963	0.968
		Sex	-0.4755	0.0192	<.0001	0.622	0.599	0.645
		Race African American	-0.1818	0.0225	<.0001	0.834	0.798	0.871
		Other	-0.0474	0.0285	0.0957	0.954	0.902	1.008
		Military Rank E7-E9	-0.0364	0.0371	0.3269	0.964	0.897	1.037
		O1-O3	-0.0534	0.0263	0.0427	0.948	0.900	0.998
		O4-O6	0.0171	0.0419	0.6829	1.017	0.937	1.104
		BMI	0.0022	0.0026	0.3963	1.002	0.997	1.007
		Fitness Test Indeterminate	-0.0230	0.0336	0.4936	0.977	0.915	1.044
		Fail	-0.1023	0.0195	<.0001	0.903	0.869	0.938
17	74	Other mental conditions						
		Tobacco Use	0.1918	0.0248	<.0001	1.211	1.154	1.272
		Age	-0.0147	0.0020	<.0001	0.985	0.982	0.989
		Sex	-1.1766	0.0255	<.0001	0.308	0.293	0.324
		Race African American	-0.4289	0.0335	<.0001	0.651	0.610	0.695
		Other	-0.2932	0.0443	<.0001	0.746	0.684	0.814
		Military Rank E7-E9	-0.1846	0.0520	0.0004	0.831	0.751	0.921
		O1-O3	-0.7179	0.0480	<.0001	0.488	0.444	0.536
		O4-O6	-0.7474	0.0726	<.0001	0.474	0.411	0.546
		BMI	0.0077	0.0038	0.0446	1.008	1.000	1.015
		Fitness Test Indeterminate	0.0416	0.0462	0.3677	1.042	0.952	1.141
		Fail	0.0070	0.0281	0.8027	1.007	0.953	1.064
18	212	Other bone disease and musculoskeletal deformities						
		Tobacco Use	-0.0872	0.0288	0.0025	0.916	0.866	0.970
		Age	0.0270	0.0021	<.0001	1.027	1.023	1.032
		Sex	-0.7358	0.0289	<.0001	0.479	0.453	0.507
		Race African American	-0.1460	0.0342	<.0001	0.864	0.808	0.924
		Other	-0.0486	0.0459	0.2899	0.953	0.871	1.042
		Military Rank E7-E9	0.0851	0.0441	0.0536	1.089	0.999	1.187
		O1-O3	-0.1670	0.0416	<.0001	0.846	0.780	0.918
		O4-O6	-0.1572	0.0534	0.0033	0.855	0.770	0.949
		BMI	-0.0010	0.0041	0.8002	0.999	0.991	1.007
		Fitness Test Indeterminate	-0.0001	0.0494	0.9977	1.000	0.908	1.102
		Fail	-0.0444	0.0293	0.1302	0.957	0.903	1.013

Continued on Next Page

Appendix 3 (Continued)

Rank	Code	Variable	Estimated Beta Coefficient	Estimated S.E.	P-Value	Odds Ratio	95% Confidence Limits	
19	254	Rehabilitation care, fitting of prosthesis, and adjustment						
		Tobacco Use	-0.0636	0.0331	0.0549	0.938	0.879	1.001
		Age	0.0288	0.0024	<.0001	1.029	1.024	1.034
		Sex	-0.3721	0.0364	<.0001	0.689	0.642	0.740
		Race African American	0.0949	0.0373	0.0110	1.100	1.022	1.183
		Other	-0.1145	0.0566	0.0432	0.892	0.798	0.996
		Military Rank E7-E9	0.0470	0.0495	0.3421	1.048	0.951	1.155
		O1-O3	-0.4096	0.0535	<.0001	0.664	0.598	0.737
		O4-O6	-0.2771	0.0628	<.0001	0.758	0.670	0.857
		BMI	0.0309	0.0047	<.0001	1.031	1.022	1.041
		Fitness Test Indeterminate	-0.2499	0.0639	<.0001	0.779	0.687	0.883
		Fail	-0.1988	0.0340	<.0001	0.820	0.767	0.876
20	196	Normal pregnancy and/or delivery						
		Tobacco Use	0.0454	0.0363	0.2107	1.046	0.975	1.124
		Age	-0.0741	0.0032	<.0001	0.929	0.923	0.934
		Sex	-4.5824	0.0712	<.0001	0.010	0.009	0.012
		Race African American	0.0439	0.0373	0.2393	1.045	0.971	1.124
		Other	0.0543	0.0505	0.2825	1.056	0.956	1.166
		Military Rank E7-E9	-0.9429	0.1569	<.0001	0.390	0.286	0.530
		O1-O3	-0.1186	0.0560	0.0342	0.888	0.796	0.991
		O4-O6	-0.0190	0.1181	0.8721	0.981	0.778	1.237
		BMI	0.0212	0.0054	<.0001	1.021	1.011	1.032
		Fitness Test Indeterminate	0.0232	0.0543	0.6685	1.024	0.920	1.138
		Fail	0.0652	0.0439	0.1372	1.067	0.979	1.163
21	66	Alcohol related mental disorders						
		Tobacco Use	1.1980	0.0469	<.0001	3.313	3.022	3.632
		Age	-0.0665	0.0044	<.0001	0.936	0.928	0.944
		Sex	0.6689	0.0706	<.0001	1.952	1.700	2.242
		Race African American	-0.2031	0.0683	0.0029	0.816	0.714	0.933
		Other	-0.1899	0.0861	0.0273	0.827	0.699	0.979
		Military Rank E7-E9	0.0336	0.1234	0.7852	1.034	0.812	1.317
		O1-O3	-1.3947	0.1563	<.0001	0.248	0.182	0.337
		O4-O6	-1.3200	0.2864	<.0001	0.267	0.152	0.468
		BMI	-0.0244	0.0071	0.0006	0.976	0.962	0.990
		Fitness Test Indeterminate	0.0700	0.0973	0.4717	1.073	0.886	1.298
		Fail	-0.2711	0.0557	<.0001	0.763	0.684	0.851

Continued on Next Page

Appendix 3 (Continued)

Rank	Code	Variable	Estimated Beta Coefficient	Estimated S.E.	P-Value	Odds Ratio	95% Confidence Limits	
22	258	Other screening for suspected conditions (not mental disorders)						
		Tobacco Use	-0.0633	0.0204	0.0019	0.939	0.902	0.977
		Age	0.0150	0.0015	<.0001	1.015	1.012	1.018
		Sex	-1.2431	0.0199	<.0001	0.289	0.277	0.300
		Race African American	0.0014	0.0227	0.9523	1.001	0.958	1.047
		Other	0.0221	0.0317	0.4869	1.022	0.961	1.088
		Military Rank E7-E9	0.0632	0.0325	0.0520	1.065	0.999	1.135
		O1-O3	-0.1199	0.0296	<.0001	0.887	0.837	0.940
		O4-O6	0.1744	0.0368	<.0001	1.191	1.108	1.280
		BMI	0.0678	0.0028	<.0001	1.070	1.064	1.076
		Fitness Test Indeterminate	0.0143	0.0345	0.6787	1.014	0.948	1.085
		Fail	0.0797	0.0202	<.0001	1.083	1.041	1.127
23	94	Other ear and sense organ disorders						
		Tobacco Use	0.0532	0.0186	0.0042	1.055	1.017	1.094
		Age	0.0101	0.0015	<.0001	1.010	1.007	1.013
		Sex	0.3022	0.0250	<.0001	1.353	1.288	1.421
		Race African American	-0.3641	0.0256	<.0001	0.695	0.661	0.730
		Other	-0.2099	0.0331	<.0001	0.811	0.760	0.865
		Military Rank E7-E9	0.0887	0.0308	0.0040	1.093	1.029	1.161
		O1-O3	-0.4682	0.0317	<.0001	0.626	0.588	0.666
		O4-O6	-0.1163	0.0374	0.0019	0.890	0.827	0.958
		BMI	0.0027	0.0028	0.3219	1.003	0.997	1.008
		Fitness Test Indeterminate	-0.0770	0.0374	0.0396	0.926	0.860	0.996
		Fail	-0.0631	0.0195	0.0012	0.939	0.904	0.975
24	259	Residual codes unclassified						
		Tobacco Use	0.0643	0.0226	0.0044	1.066	1.020	1.115
		Age	0.0108	0.0017	<.0001	1.011	1.007	1.014
		Sex	-0.5751	0.0247	<.0001	0.563	0.536	0.591
		Race African American	0.1002	0.0261	0.0001	1.105	1.050	1.163
		Other	0.1043	0.0359	0.0037	1.110	1.034	1.191
		Military Rank E7-E9	0.0403	0.0372	0.2794	1.041	0.968	1.120
		O1-O3	-0.0931	0.0341	0.0064	0.911	0.852	0.974
		O4-O6	0.1076	0.0432	0.0129	1.114	1.023	1.212
		BMI	0.0537	0.0032	<.0001	1.055	1.049	1.062
		Fitness Test Indeterminate	-0.0282	0.0420	0.5017	0.972	0.895	1.056
		Fail	0.0919	0.0227	<.0001	1.096	1.049	1.146

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Appendix 3 (Continued)

Rank	Code	Variable	Estimated Beta Coefficient	Estimated S.E.	P-Value	Odds Ratio	95% Confidence Limits	
25	253	Allergic reactions						
		Tobacco Use	-0.0866	0.0222	<.0001	0.917	0.878	0.958
		Age	-0.0026	0.0017	0.1290	0.997	0.994	1.001
		Sex	-0.6822	0.0224	<.0001	0.506	0.484	0.528
		Race African American	0.1390	0.0250	<.0001	1.149	1.094	1.207
		Other	0.1820	0.0330	<.0001	1.200	1.124	1.280
		Military Rank E7-E9	0.0128	0.0390	0.7425	1.013	0.938	1.093
		O1-O3	-0.1859	0.0330	<.0001	0.830	0.778	0.886
		O4-O6	-0.0150	0.0453	0.7400	0.985	0.901	1.077
		BMI	-0.0012	0.0032	0.7083	0.999	0.993	1.005
		Fitness Test Indeterminate	-0.0746	0.0399	0.0616	0.928	0.858	1.004
		Fail	-0.0746	0.0232	0.0013	0.928	0.887	0.971
26	75	Personal history of mental disorder, mental and behavioral						
		Tobacco Use	0.2254	0.0207	<.0001	1.253	1.203	1.305
		Age	-0.0255	0.0017	<.0001	0.975	0.971	0.978
		Sex	-0.1376	0.0251	<.0001	0.871	0.830	0.915
		Race African American	-0.0935	0.0271	0.0006	0.911	0.864	0.960
		Other	-0.0928	0.0361	0.0101	0.911	0.849	0.978
		Military Rank E7-E9	-0.3119	0.0460	<.0001	0.732	0.669	0.801
		O1-O3	-0.6424	0.0401	<.0001	0.526	0.486	0.569
		O4-O6	-0.5842	0.0600	<.0001	0.558	0.496	0.627
		BMI	0.0069	0.0032	0.0307	1.007	1.001	1.013
		Fitness Test Indeterminate	-0.0236	0.0423	0.5757	0.977	0.899	1.061
		Fail	-0.0683	0.0233	0.0034	0.934	0.892	0.978
27	72	Anxiety, somatoform, dissociative, and personality disorders						
		Tobacco Use	0.1266	0.0290	<.0001	1.135	1.072	1.201
		Age	-0.0031	0.0023	0.1763	0.997	0.992	1.001
		Sex	-1.0195	0.0298	<.0001	0.361	0.340	0.382
		Race African American	-0.3116	0.0377	<.0001	0.732	0.680	0.788
		Other	-0.3195	0.0527	<.0001	0.726	0.655	0.806
		Military Rank E7-E9	-0.0665	0.0554	0.2302	0.936	0.839	1.043
		O1-O3	-0.5320	0.0515	<.0001	0.587	0.531	0.650
		O4-O6	-0.8293	0.0823	<.0001	0.436	0.371	0.513
		BMI	-0.0112	0.0044	0.0112	0.989	0.980	0.997
		Fitness Test Indeterminate	0.0682	0.0529	0.1967	1.071	0.965	1.187
		Fail	0.0402	0.0321	0.2110	1.041	0.977	1.109

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Appendix 3 (Continued)

Rank	Code	Variable	Estimated Beta Coefficient	Estimated S.E.	P-Value	Odds Ratio	95% Confidence Limits	
28	69	Affective disorders						
		Tobacco Use	0.2704	0.0375	<.0001	1.311	1.218	1.410
		Age	0.0044	0.0030	0.1430	1.004	0.999	1.010
		Sex	-1.4568	0.0384	<.0001	0.233	0.216	0.251
		Race African American	-0.7124	0.0553	<.0001	0.490	0.440	0.547
		Other	-0.4541	0.0717	<.0001	0.635	0.552	0.731
		Military Rank E7-E9	-0.2043	0.0741	0.0058	0.815	0.705	0.943
		O1-O3	-0.7854	0.0749	<.0001	0.456	0.394	0.528
		O4-O6	-0.8378	0.1047	<.0001	0.433	0.352	0.531
		BMI	0.0249	0.0058	<.0001	1.025	1.014	1.037
		Fitness Test Indeterminate	0.1647	0.0659	0.0124	1.179	1.036	1.342
		Fail	0.0090	0.0432	0.8358	1.009	0.927	1.098
29	84	Headache, including migraine						
		Tobacco Use	-0.0563	0.0258	0.0291	0.945	0.899	0.994
		Age	-0.0006	0.0020	0.7583	0.999	0.996	1.003
		Sex	-1.4092	0.0246	<.0001	0.244	0.233	0.256
		Race African American	0.1205	0.0281	<.0001	1.128	1.068	1.192
		Other	-0.0493	0.0413	0.2321	0.952	0.878	1.032
		Military Rank E7-E9	-0.1662	0.0481	0.0005	0.847	0.771	0.931
		O1-O3	-0.6898	0.0458	<.0001	0.502	0.459	0.549
		O4-O6	-0.7801	0.0677	<.0001	0.458	0.401	0.523
		BMI	-0.0060	0.0038	0.1122	0.994	0.987	1.001
		Fitness Test Indeterminate	0.0303	0.0435	0.4858	1.031	0.946	1.123
		Fail	0.0689	0.0274	0.0117	1.071	1.015	1.130
30	58	Other nutritional, endocrine, and metabolic disorders						
		Tobacco Use	0.0454	0.0284	0.1102	1.046	0.990	1.106
		Age	-0.0297	0.0022	<.0001	0.971	0.967	0.975
		Sex	-1.8352	0.0315	<.0001	0.160	0.150	0.170
		Race African American	-0.3980	0.0338	<.0001	0.672	0.629	0.718
		Other	-0.0631	0.0468	0.1778	0.939	0.857	1.029
		Military Rank E7-E9	-0.1674	0.0521	0.0013	0.846	0.764	0.937
		O1-O3	-0.5027	0.0528	<.0001	0.605	0.545	0.671
		O4-O6	-0.2746	0.0697	<.0001	0.760	0.663	0.871
		BMI	0.3765	0.0041	<.0001	1.457	1.445	1.469
		Fitness Test Indeterminate	0.1823	0.0506	0.0003	1.200	1.087	1.325
		Fail	0.2833	0.0279	<.0001	1.327	1.257	1.402

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VITA

Paul Nelson was born in Oakland, California and grew up in Oxford, Mississippi. There, he and his parents [redacted] were joined by a sister [redacted]

After graduation from Oxford High School, Paul continued his education in Oxford as a Carrier Foundation Scholar at the University of Mississippi. He graduated in 1989 with a degree in physics, a commission in the United States Air Force, a boat load of enthusiasm, a boat (actually a 1975 Cadillac convertible), and a best friend. Fortunately, while the car is no longer around, [redacted] still is.

Paul graduated medical school at the Uniformed Services University of the Health Sciences (USUHS) in 1993. He completed a Transitional Internship and Family Practice Residency at Malcolm Grow USAF Medical Center at Andrews Air Force Base, Maryland. Assignments took the family to Incirlik Air Base, Turkey, and Spangdahlem Air Base, Germany. While at Spangdahlem, Doc Nelson, now "VooDoo", spent his most challenging and rewarding professional and personal years in service to the 23rd Fighter Squadron's "Fightin' Hawks", the world's greatest fighter squadron. From here, he applied and was accepted to the Residency in Aerospace Medicine (RAM) and the Master's Program at The University of Texas Health Science Center at Houston School of Public Health San Antonio Program.

Paul and [redacted] are blessed with [redacted] and [redacted]. As a family they enjoy travel, gardening, home remodeling, animals, and photographing trains [redacted] is very patient). Paul is anxious to return to an operational unit after graduation from the RAM, but the entire family is enjoying their stay in San Antonio.

This thesis was typed by Paul H. Nelson, M.D.